

COMPANY: Aplicaciones Tecnológicas, S.A.

AREA: Lightning Protection

PRODUCT: CONDUCTIVER PLUS

REFERENCE: AT – 10L

AT-10L CONDUCTIVER PLUS



CONDUCTIVER PLUS is a non-corrosive and ecological earthing conductivity improver gel. The product is composed by a basic electrolyte, which contributes to the conductive capacity of the compound, upgraded by other ingredients that help the conductivity in an almost immediate way and complement the action of the basic electrolyte.

1. PRESENTATION

- 5 litres container (used as a measure container)
- GEL 1 packet
- GEL 2 packet

Container

Material: polypropylene

Dimensions: $\phi_{inf} 195 \times \phi_{sup} 235 \times$ Height 198mm

Capacity: 5 litres

Components

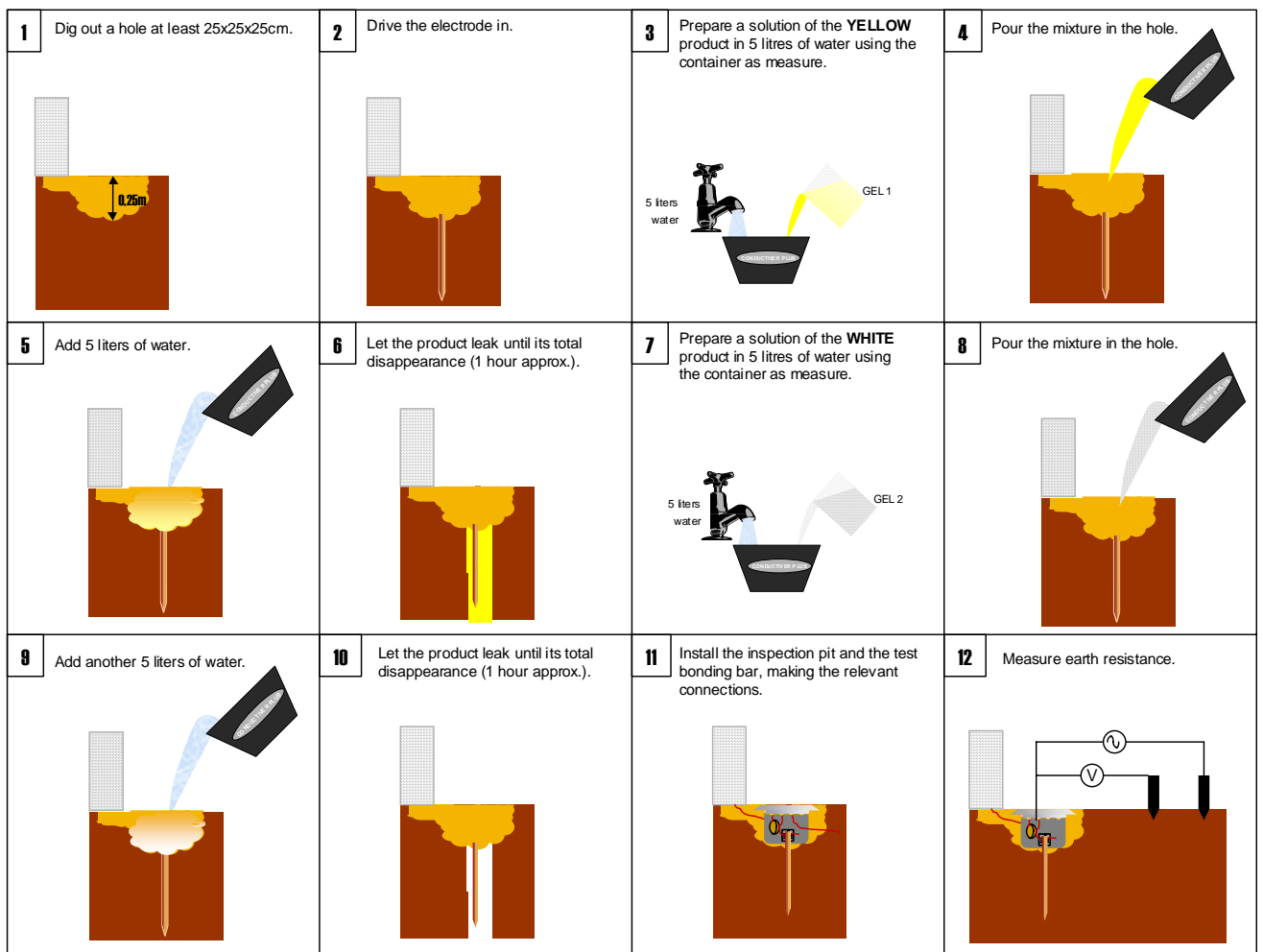
GEL 1	GEL 2
Colour: yellow	Colour: white
Dimensions: 20 × 16cm	Dimensions: 18 × 24cm
Weight: 1,705kg	Weight: 2,205kg
Texture: liquid	Texture: flakes

One dose of CONDUCTIVER PLUS is composed by these components and 20 liters of water, mixed as explained in point 2.

2. PREPARATION

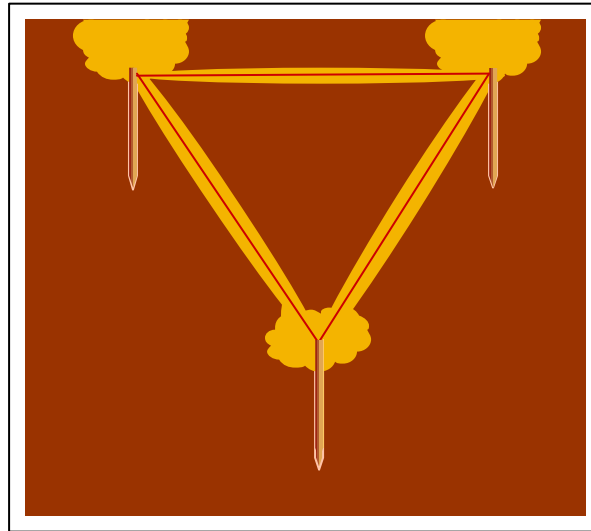
- Soil can be dry; no previous preparation is needed.
- Prepare a solution of the **YELLOW** product in 5 litres of water using as a measurement the container.
- Pour the first solution in the ground and add another 5 liters of water.
- Let the product leak until its total disappearance (approx. 1 hour, depending on the soil).
- Rinse the bucket carefully
- Prepare a second solution with the **WHITE** product and add 5 litres of water again. Pour this homogeneous mixture on the ground. Add another 5 liters of water. Let it leak until its total absorption (approx. 1 hour).
- Once the second product is leaked, measurement can be done.

Instructions for a conventional simple electrode:

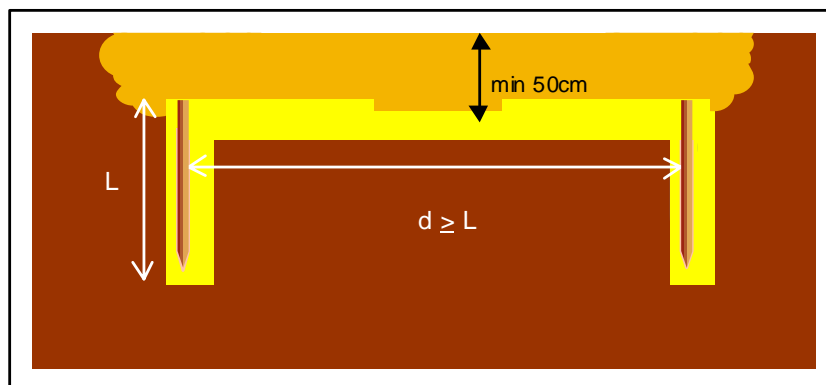


Other cases:

a) Earth Termination system formed by several interconnected rods



- Minimum total length of all the buried electrodes must be of 6 meters
- Arrangement should be forming a line or triangle, separating the electrodes a distance at least as long as their buried length.
- They should be bonded with an identical or compatible conductor to the one used for the down-conductor.
- The trench where the conductor is buried should be of at least 50cm deep.
- CONDUCTVER PLUS should be applied both on the electrodes and in the trenches where the conductor lies.



EARTH TERMINATION SYSTEMS FOR HIGH RESISTIVITY SOILS

The Earth Termination System is a basic element in any electrical installation. Earth Termination Systems are installed especially with the aim of limiting the voltage that, respect to the earth, can eventually appear at the metallic masses, ensuring the protection activation and eliminating or decreasing the risk of failures in the electric elements of the installation.

Therefore, Earth Termination Systems protects both equipment and persons from dangerous voltages.

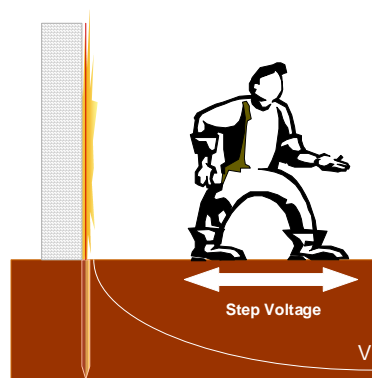
Whatever the origin of the voltage is, a low earth resistance is essential and its properties should maintain along the time, even during dry periods.

In many cases, this low resistance is achieved by installing very long electrodes, searching deep humid layers. However, this is not effective for lightning discharges, since lightning current, which has to be dissipated, is very high (10s kiloamperes, usually) but very short (milliseconds). This implies that, for several physical reasons, the current does not reach the end of the electrode. Current conduction and dissipation occurs at the upper part of the electrode, where soil resistivity is high.

Soil **humidity** is a decisive factor for Earth Termination System impedance. It is also very significant if the soil is compact or if it has been dug recently. If a trench has been made for the earthing installation, if it has been raining or if water is poured during the installation, a good result can be obtained but this resistance will not remain for a long time.

Some installers use hygroscopic salts for increasing humidity retention around the electrode. However, just this addition is not long-term effective, since they are carried away by the rain thus disappearing after some time. Besides, while they remain around, these salts can cause corrosion problems to the electrode.

It is essential to guarantee good **current dispersion**. When lightning current reaches the earthing, the accumulated energy produces very large voltage differences at the floor, high enough to electrocute a person with the shock due to the voltage difference between the feet (**step voltage**).



3. CONDUCTIVER PLUS GEL

Soil conductivity is almost entirely electrolytic, due to the solved salt, adhered to the sand and clay grains, that it contains.

Therefore, it is possible to increase soil conductivity, improving its capacity of absorption, water retention and increasing the amount of solved salts.

It is very simple to achieve this effect in an elemental way, just adding any electrolyte such as common salt (NaCl) or calcium carbonate (Na_2CO_3), but these salts are highly soluble and slightly adherent, thus being easily poored by filtered waters. Therefore their action is short and not practical. Another inconvenient is that common salt is very corrosive for earth electrodes.

Average pluviometry in Spain is considered to be around $700\text{L}/\text{m}^2\cdot\text{año}$. The need of product has to be studied taking into account the specific amount of rain per year in the selected area. A 60% of the rain is estimated to evaporate so, for the case of Spain, an average of $280\text{L}/\text{m}^2\cdot\text{año}$ is estimated to leak into the soil.

CONDUCTIVER PLUS components have been selected **by their solubility**, since the aim is obtaining a slightly soluble product by the reaction of soluble products, thus obtaining a lasting product deposit around the electrode.

The reactivés employed are products which reaction produces highly conductive compounds, lowering then ground resistance, especially in poorly salty soils.

The components have been selected also by ecological parameters, choosing always those non-contaminating and non-corrosive, taking also into account solubility constants both in reactive and resultant products, combining very soluble reactivés that provide an immediate conductivity rise and insoluble resultant products that assure a ionic reserve, able to maintain this conductivity increase.

CONDUCTIVER PLUS gel characterizes by the following:

- It is able to create partially ionized electrolytes, with big charge and a high capability for water retention and gel formation.
- It remains for a long time in the ground, due to links formed with soil particles.
- It increases soil conductivity (approx. 200% for $700\text{L}/\text{m}^2$ pluviosity for over one year)
- It is not corrosive for earth electrodes.
- It is completely ecological.

CONDUCTIVER PLUS gel is composed of a base-electrolyte, providing conductive capability, and other componentes that help conduction and complement the base-electrolyte action.

The basis of base-electrolyte conductivity improving action is the formation of a slightly soluble (max. 0.2% solubility) but highly hygroscopic product. Therefore, the product is able to increase the soil capability of humidity retention, multiplying by 3 to 20 times the soil conductivity.

CONDUCTIVER PLUS forms a high conductivity gel where the electrode gets in contact with the soil and around this contact. If the products are applied in the right order, this ions spread very quickly through the formed gel. This allows later additions of gel after a period, in case a even lower electrode resistance is required.

CONDUCTIVER PLUS gel is a complex chemical product, insoluble in water, highly conductive, which does not disappear after continual washing. Laboratory tests have probed that there are not changes in its physical properties after forced washings with water. The gel is also thermoestable between -60°C and 60°C .

The advantage of CONDUCTIVER PLUS gel over other chemical soil treatment methods is that it precipitates in the soil forming an homogeneous mass, with a single contact surface, instead of many contact points obtained when there are chrystals or amorphous substances in the soil.

Components supporting the base-electrolyte action are highly soluble ions, assuring very rapid effect in conductivity rise. Therefore, it is necessary to add the two products separately (GEL 1 and GEL 2). Then the formation of the base-electrolyte, little soluble, happens inside the soil, thus assuring maximum efficiency.

The separate addition of the components allows CONDUCTIVER PLUS gel to become flexible and adaptable to each user's necessities.

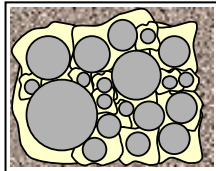
CONDUCTIVER PLUS gel can be applied on any electrode (rod, cable , plate, etc.) just by pouring the proper mixtures in the ground surrounding the electrode. It can be also applied on any kind of soil, with different doses depending on the resistivity and peculiarities of the treated soil.

Dosification

At least one dose of CONDUCTIVER PLUS is recommended per grounding element. For achieving larger decreases in earthing resistance, higher doses can be applied. Higher amounts of product will provide better results.

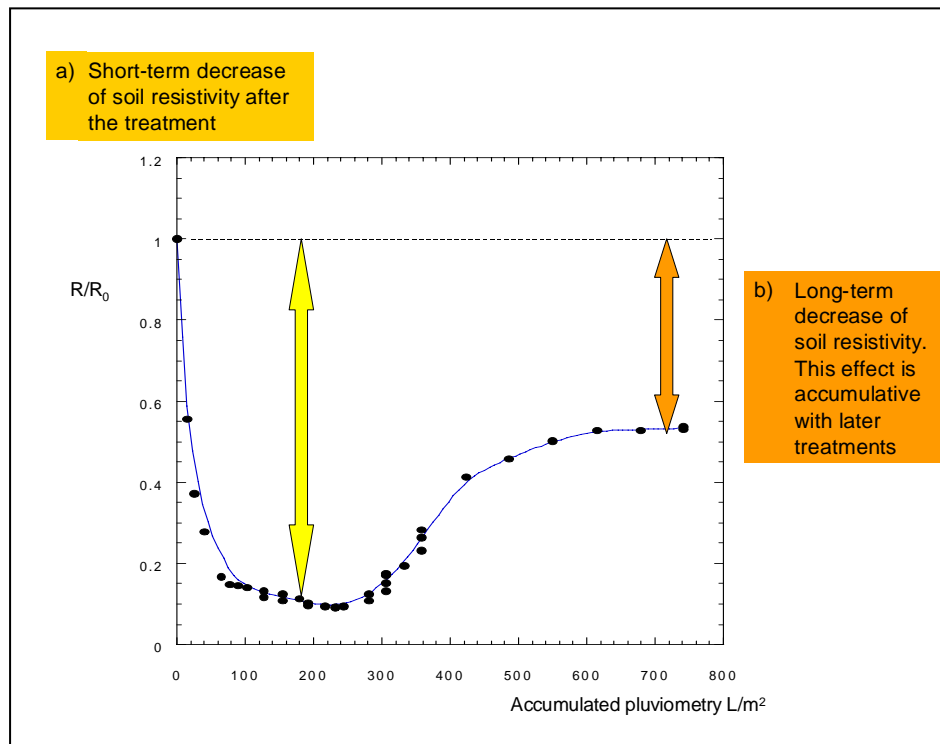
Life

CONDUCTIVER PLUS gel maintains soil conductivity during a 1-2 years period. After this period it is convenient to apply the treatment again. The advantage is that CONDUCTIVER plus effect is acumulative, that is, each treatment improves soil electric characteristics and thus each time the starting resistivity is lower.



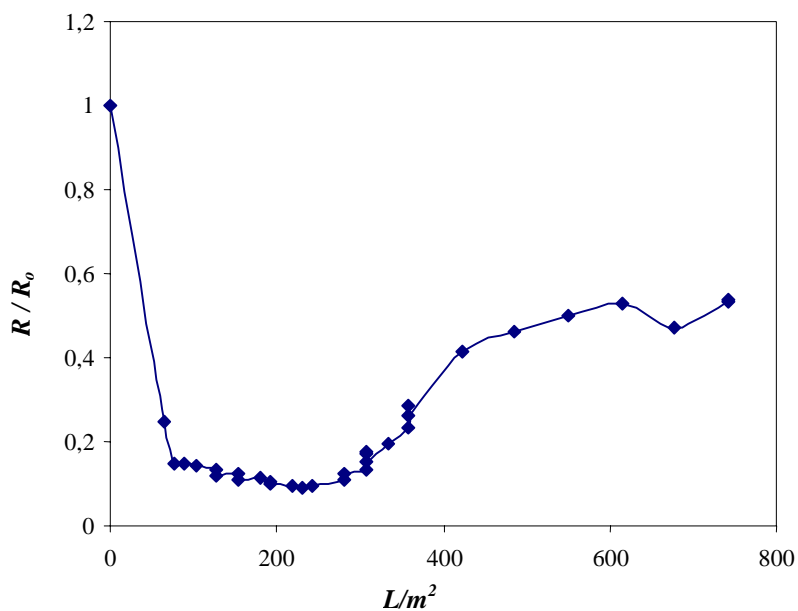
In gravel soils, CONDUCTIVER PLUS surrounds the stones with a conductive gel, providing effective long-term decrease of the resistivity.

CONDUCTIVER PLUS gel effects are perceptible in every kind of soil, especially in gravel soils, where the reduction in relative resistivity reaches a 90% (measured in tests performed by the Technical University of Valencia -Spain-, Department of Chemistry).



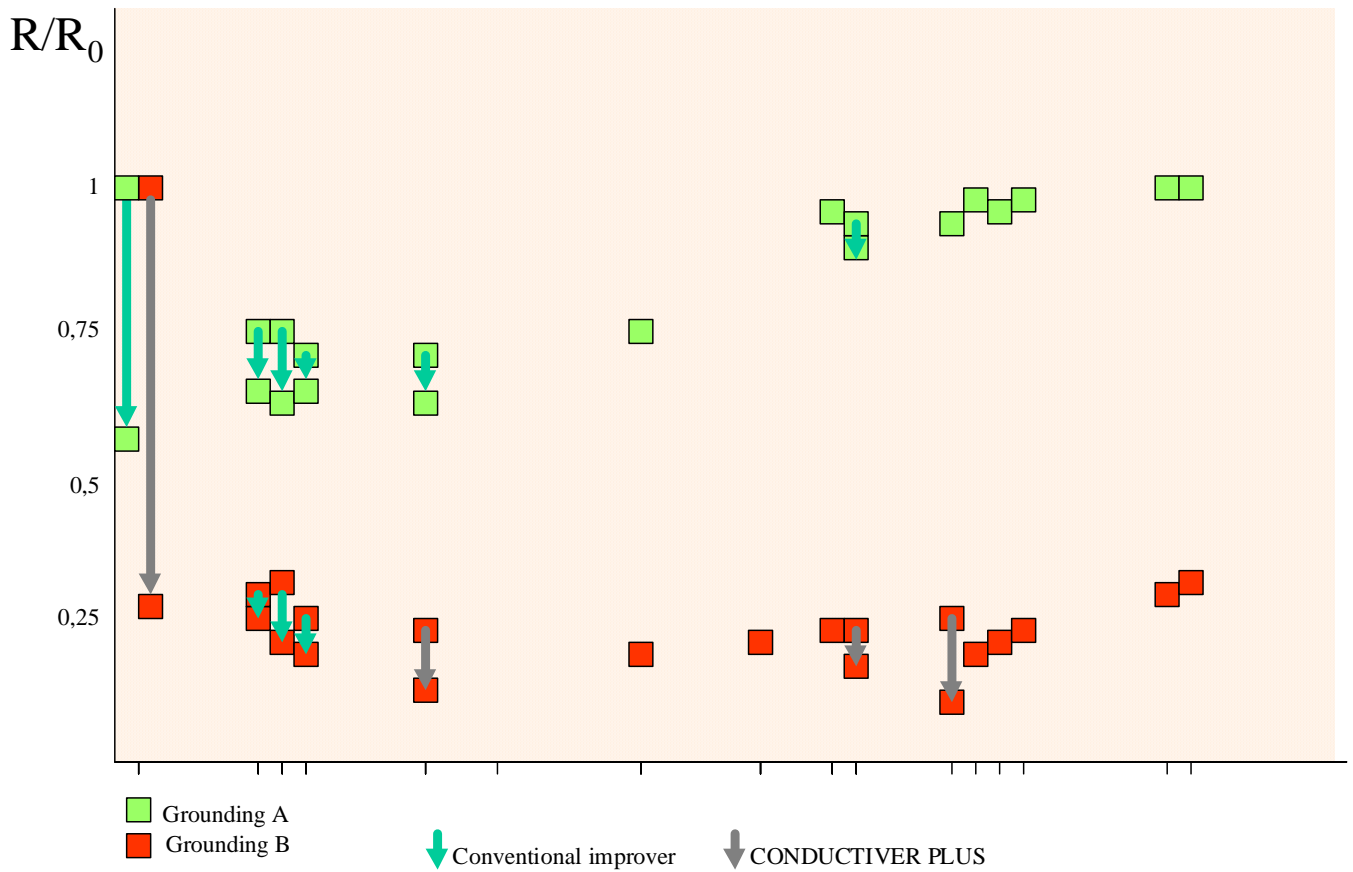
As shown in the graphic, soil conductivity decreases almost immediately, reaching a 90% reduction. Afterwards, with a normal pluviometry, soil resistance remains around 50% the starting value.

There are many soil characteristics that strongly affect its conductivity (soil movement, pluviometry, nearby and underground streams, ...). Therefore, it is not possible to give a general table determining soil conductivity for each CONDUCTIVER PLUS dose applied. As an example, this graphic shows the relationship between relative earth resistance and poured water:



In order to prove CONDUCTIVER PLUS efficiency, a study was carried out during several months in two groundings, placed in a high resistivity soil and with 5 meters separation between them.

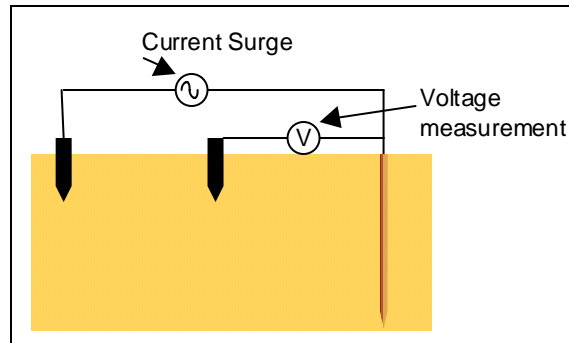
Grounding A was treated with a conventional soil improver every time that a new dose of CONDUCTIVER PLUS was added to Grounding B. Results show not only a higher immediate resistance reduction with CONDUCTIVER PLUS but also good condition maintenance during a longer time.



4. EARTH RESISTANCE MEASUREMENT

For the case of earth terminations included in the lightning protection system, it should be convenient to measure earthing **impedance**. That means to take the measures using impulse current, or at least not to employ just direct current, evaluating then not only the resistive component but also the inductive one, which highly influences the earthing response when current is impulsional.

However, nowadays few installers are provided with a proper earth resistance tester for this measurement. Besides, the existing high frequency telurometers generate a very low current. Anyway, both these and the conventional telurometers can be used for obtaining an approximated earthing impedance.



It is essential that conventionally measured resistance get low values (lower than 10Ω).

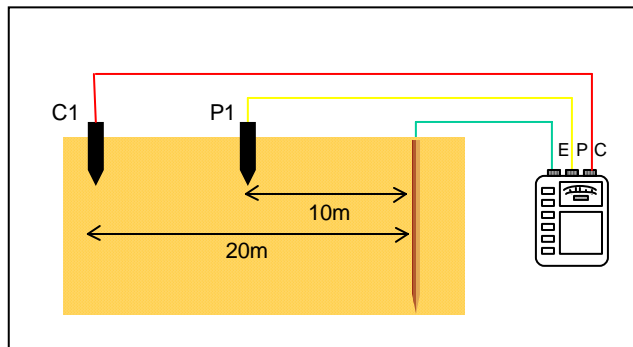
In case this value is not reached, further interconnected earth electrodes must be placed and a conductivity improver product, hygroscopic and enduring such as CONDUCTIVER PLUS should be used.

For testing earth resistance, two reference points are needed. The distance between those points and the earth termination system must be at least 10 and 20 meters respectively. They can be taken in any direction although is recommendable to place them in line.

It is important to separate the lead wires carefully. If the measurement is made with the lead wires twisted or in touch with each other it will be affected by the induction of current or voltage, altering the real value of the earth resistance.

The way for taking the reference points is the following:

- If possible, it is recommendable to stick the auxiliary test bars into the moist earth, keeping the above mentioned distances.
- If the soil is hard or not humid enough, references can be taken by connecting the tester to metallic elements, stuck or embedded in the soil, only if they are voltage-free and far away from electromagnetic influences.



- When none of those ways is possible, references can also be provided by covering completely the two auxiliary bars with wet clothes. However, this measure is not valid for asphalted grounds, where simplified measurement has to be applied.
- For simplified measurement, only the lightning protection system earth termination and a reference earth termination are connected.

5. SAFETY DATA SHEET

Danger identification

Eyes, skin and respiratory tract irritation

First aid

General indications: In case of fainting, do not have the person drink nor induce vomiting.

Inhalation: Move to fresh air

Skin contact: Flush with water. Take polluted clothes off.

Eyes: Flush with large amounts of water for at least 15 minutes, maintaining eyelids open. In case of irritation, get medical assistance.

Ingestion: Drink large amounts of water. Induce vomiting. Get medical assistance.

Fire fighting measures

Extinguishing media: Appropriate for the environment.

Especial risks: Non-flammable

Measures in case of accidental release

Individual protective measures: Do not inhale fumes

Environmental protection: Do not allow entry in soil, water courses and drains.

Cleaning methods: Collect with absorbent material (Panreac General Absorbent, Kieselguhr, etc.) or, if not available, with sand or dry soil. Throw out in suitable containers for later elimination according to the Standards. Clean remainders with large amounts of water. Neutralise with hydrochloric acid.

Handling & Storage

Handling: No special handling techniques are required.

Storage: Maintain enclosures properly closed. Ambient temperature. Dry environment.

Personal protection-exposition controls

Breath protection: In case of fume/aerosol formation, use a proper breathing equipment

Hand protection: Use proper gloves.

Eye protection: Use proper goggles.

Particular hygienic measures: Take polluted clothes off. Wear proper working clothes. Wash hands before working breaks and end of work.

Stability and Reactivity

Conditions to be avoided: High temperatures.

Hazardous effect to health

By inhalation: Respiratory tract irritations.

By skin contact: Irritations, burns.

By eye contact: Irritations, burns. Risk of vision upset.

By ingestion: Vomits. Irritations in mouth, throat, oesophagus and intestinal tract mucus.

Systemic effects: Saliva flow, collapse

Others: Other hazardous characteristics are not excluded. Follow ordinary preventive measures when handling chemical products.